Soil Series as a Central Pedological Concept

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Background

A soil series concept is an ever-evolving understanding of a collection of soil profile observations, their connection to the landscape, and functional limits on the range in characteristics that affect management. Historically, the soil series has played a pivotal role in the development of soil-landscape theory, modern soil survey methods, and concise delivery of soils information to the end-user. In other words, soil series form the palette from which soil survey reports are crafted. Over the last 20 years the soil series has received considerable criticism as a means of soil information organization (soil survey development) and delivery (end-user application of soil survey data), with increasing pressure (internal and external) to retire the soil series in favor of empirical groupings or arrays of properties.

We propose that a modern re-examination of soil series information could help address several of the long-standing critiques of soil survey: consistency across survey vintage and political divisions and more robust estimates of soil properties and associated uncertainty. A new library of soil series data would include classic narratives describing morphology and management, quantitative descriptions of soil properties and their ranges, graphical depiction of the relationships between associated soil series, block diagrams illustrating soil-landscape models, maps of series distribution, and a probabilistic representation of a "typical" soil profile. These data would be derived from re-correlation of existing morphologic and characterization data informed by modern statistical methods and regional expertise.
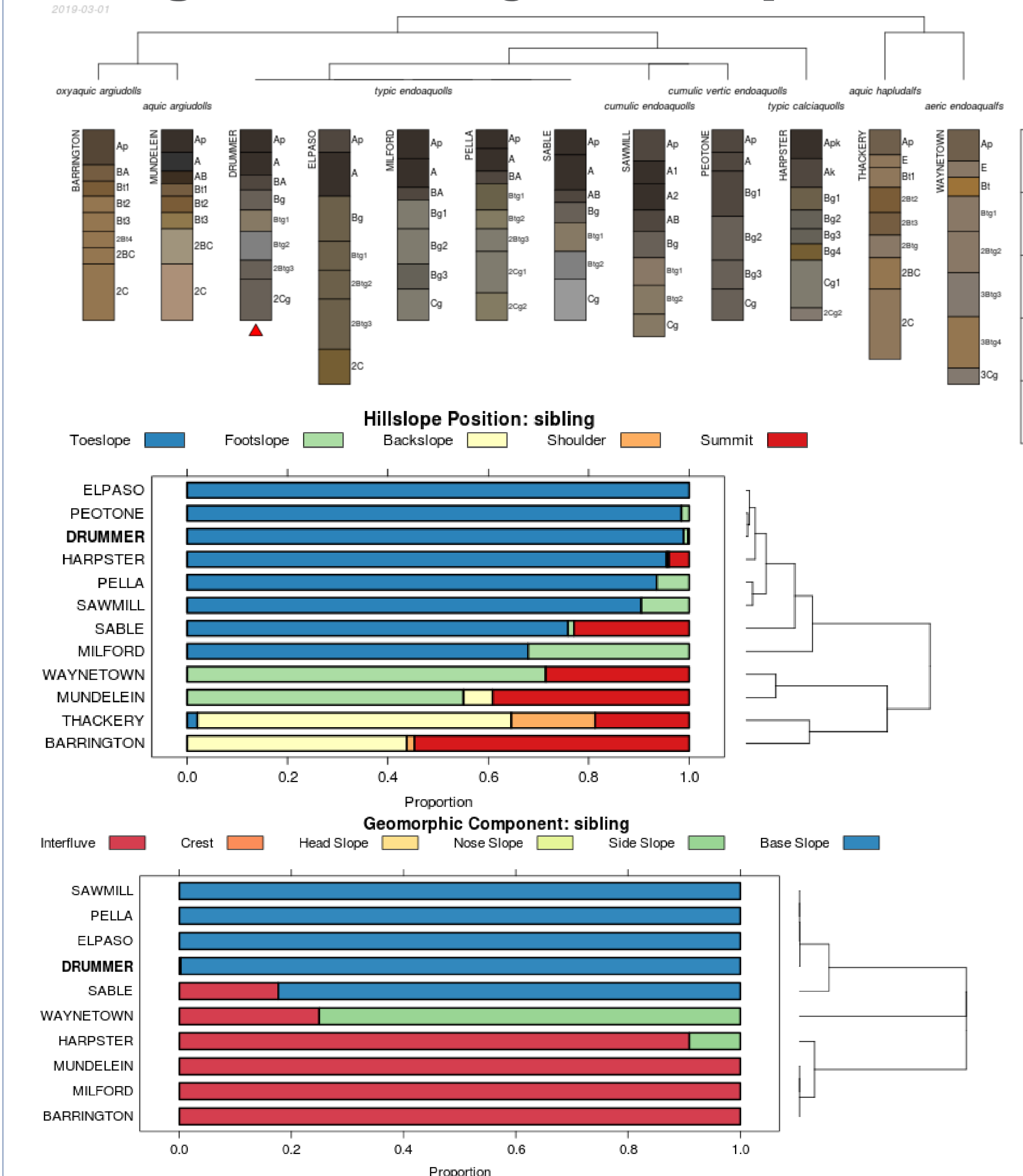
Objectives

- **Consolidate** (when possible) the large number of existing series.
- Simpler and more **well-defined series** concepts will inform similar updates to component concepts.
- The **future of soil survey** will partially depend on our point data. The value of our point data is limited by taxonomic and series correlation which are often abandoned after initial mapping or update work have completed.
- Soil series are a convenient way to **derive central tendency and RIC**; spatial models for soil series labels are an efficient way to generate predictions that contain internally consistent suites of soil properties.
- **Disaggregation of component data** is only possible when component concepts (and therefore series concepts) are internally consistent (e.g. in soil property space) and spatially consistent. Large-scale, realistic disaggregation of SSURGO data will be confounded until those entities to be disaggregated are better defined.
- **Quantitative evaluation of similarity** (among pedons, between concepts, etc.) is exceedingly difficult. Since the 1960's there have been numerous attempts, none of which have been widely adopted. An OSD database would (eventually) support this kind of work, ideally yielding a measure of similarity between all series concepts based on a core set of site/horizon attributes.
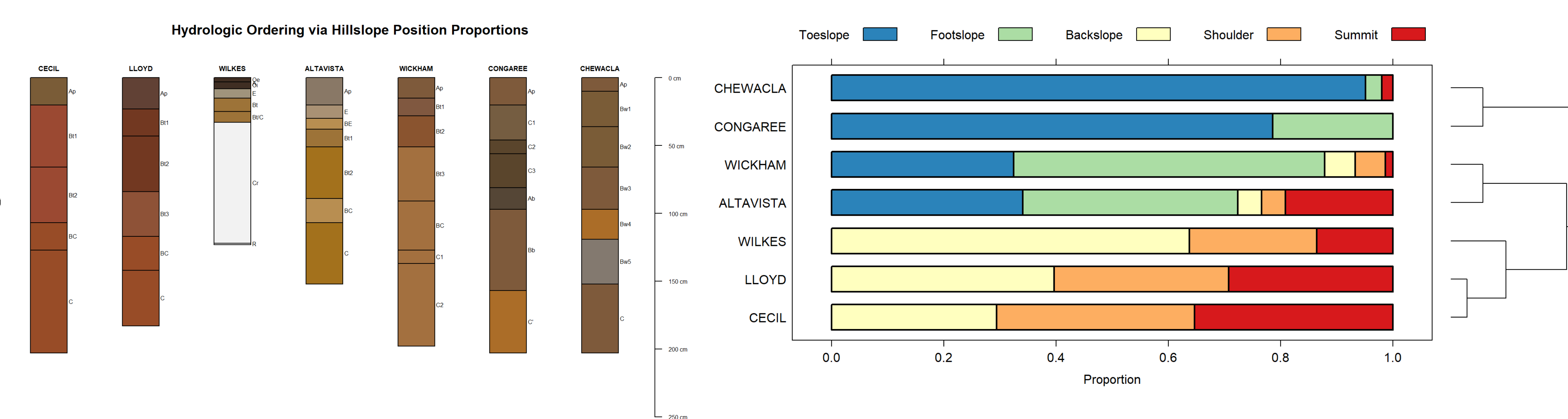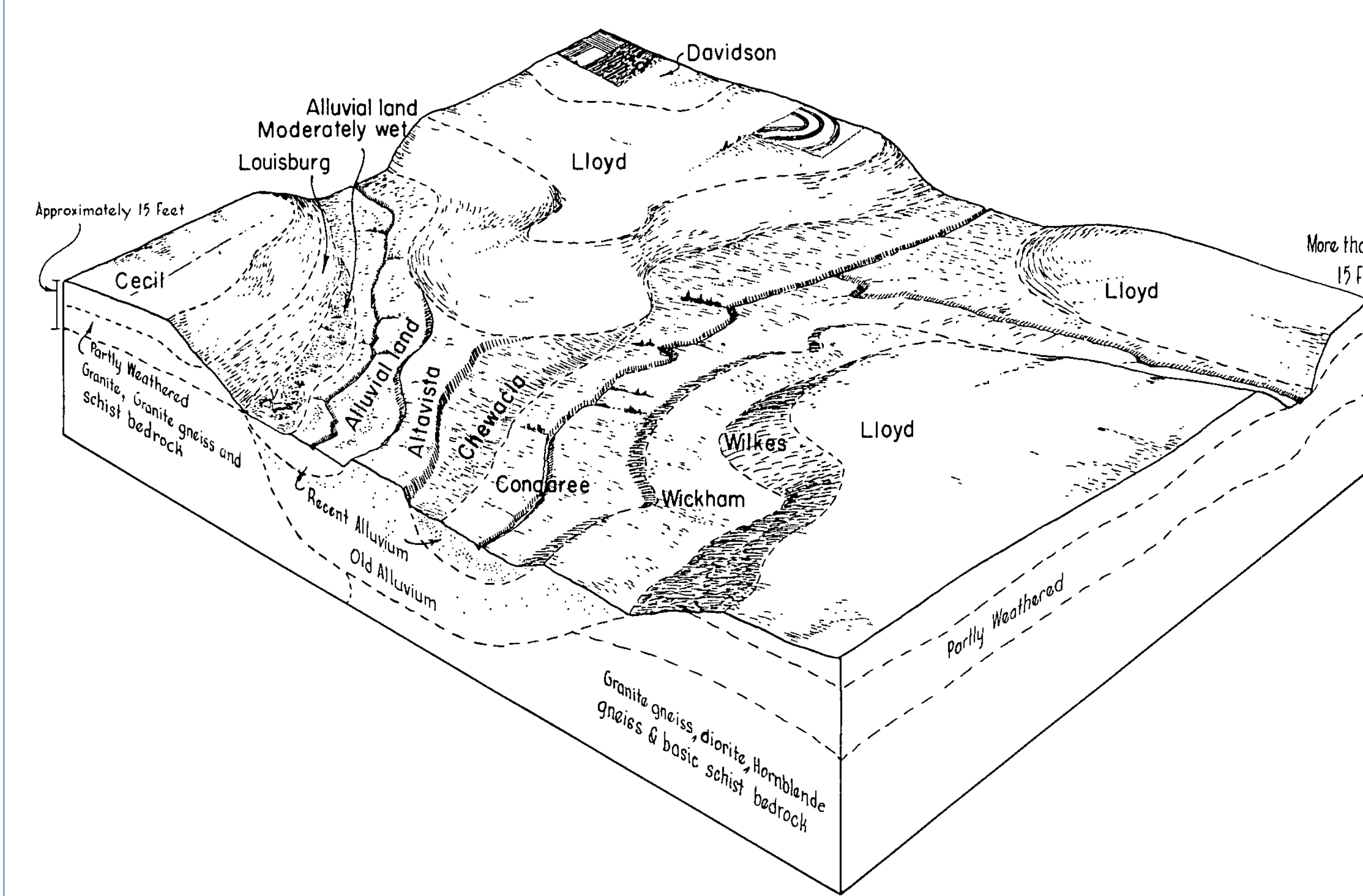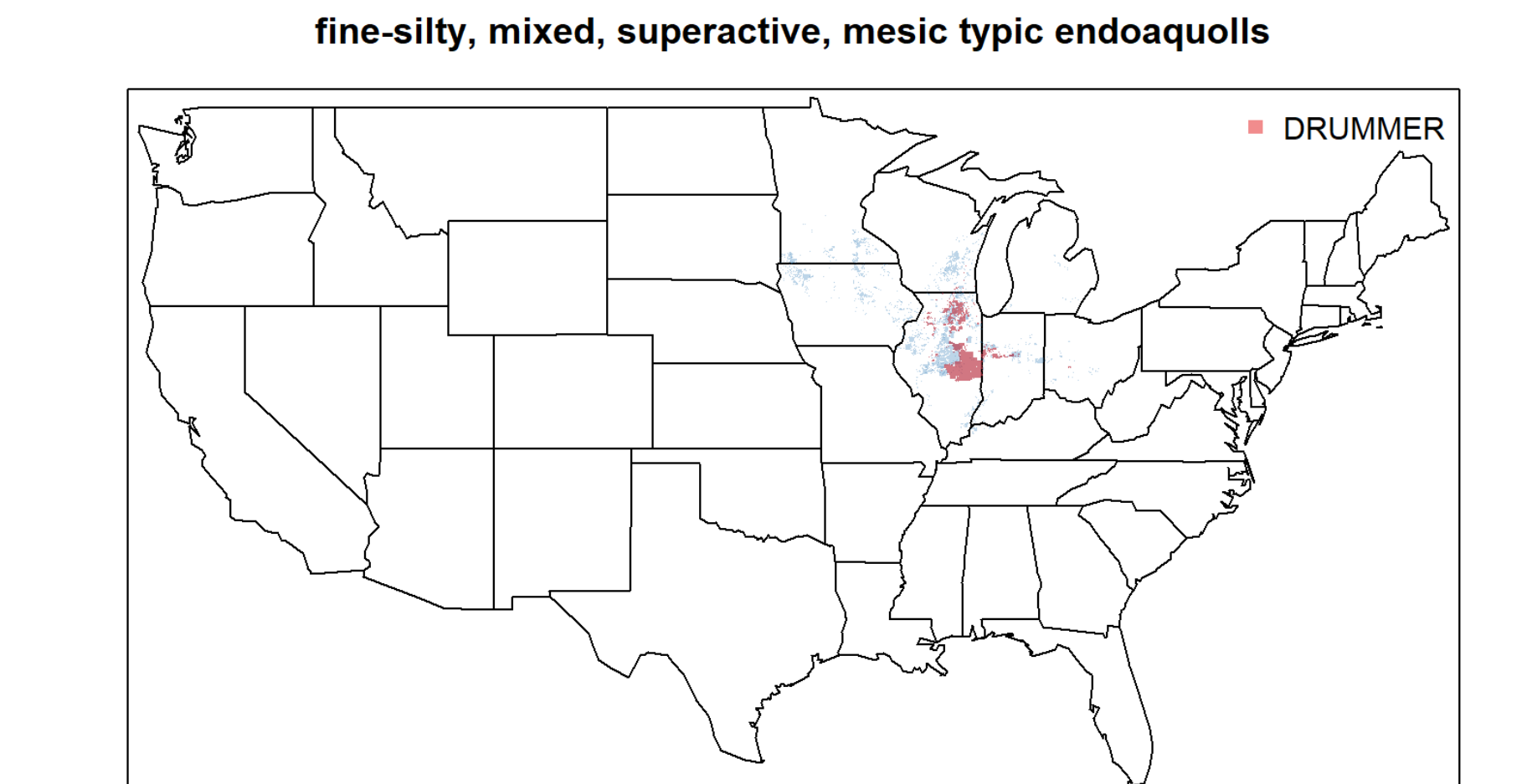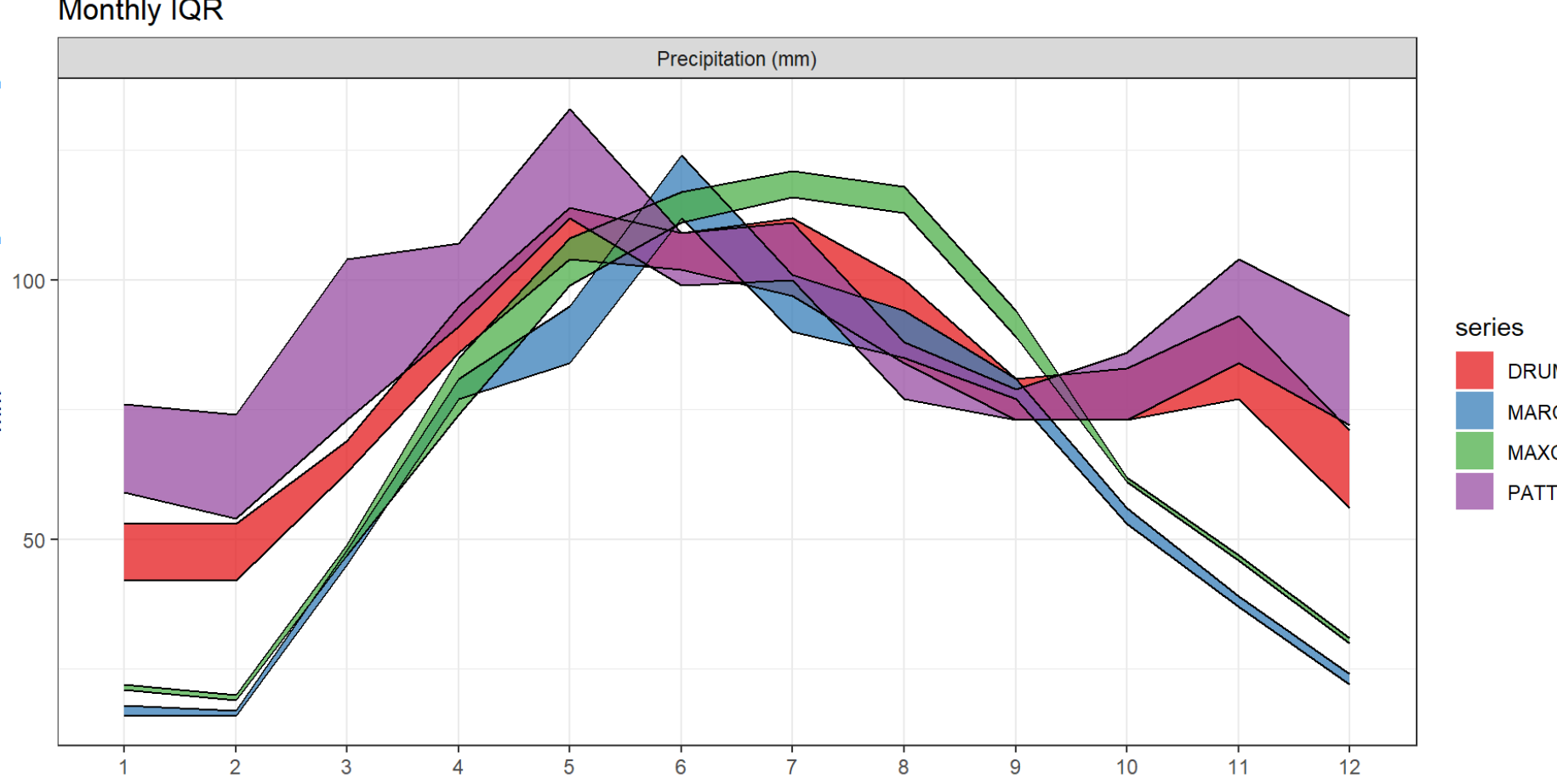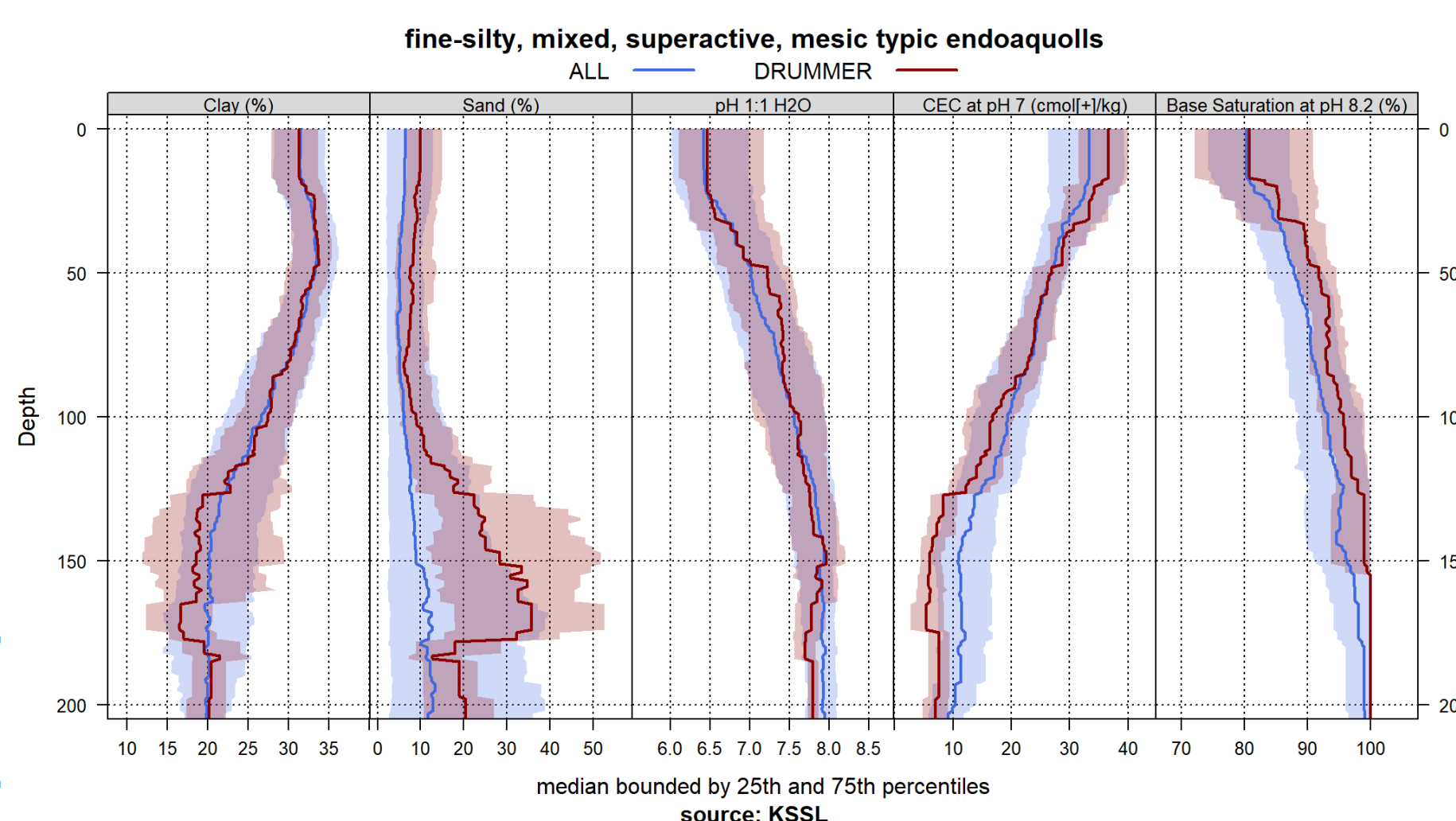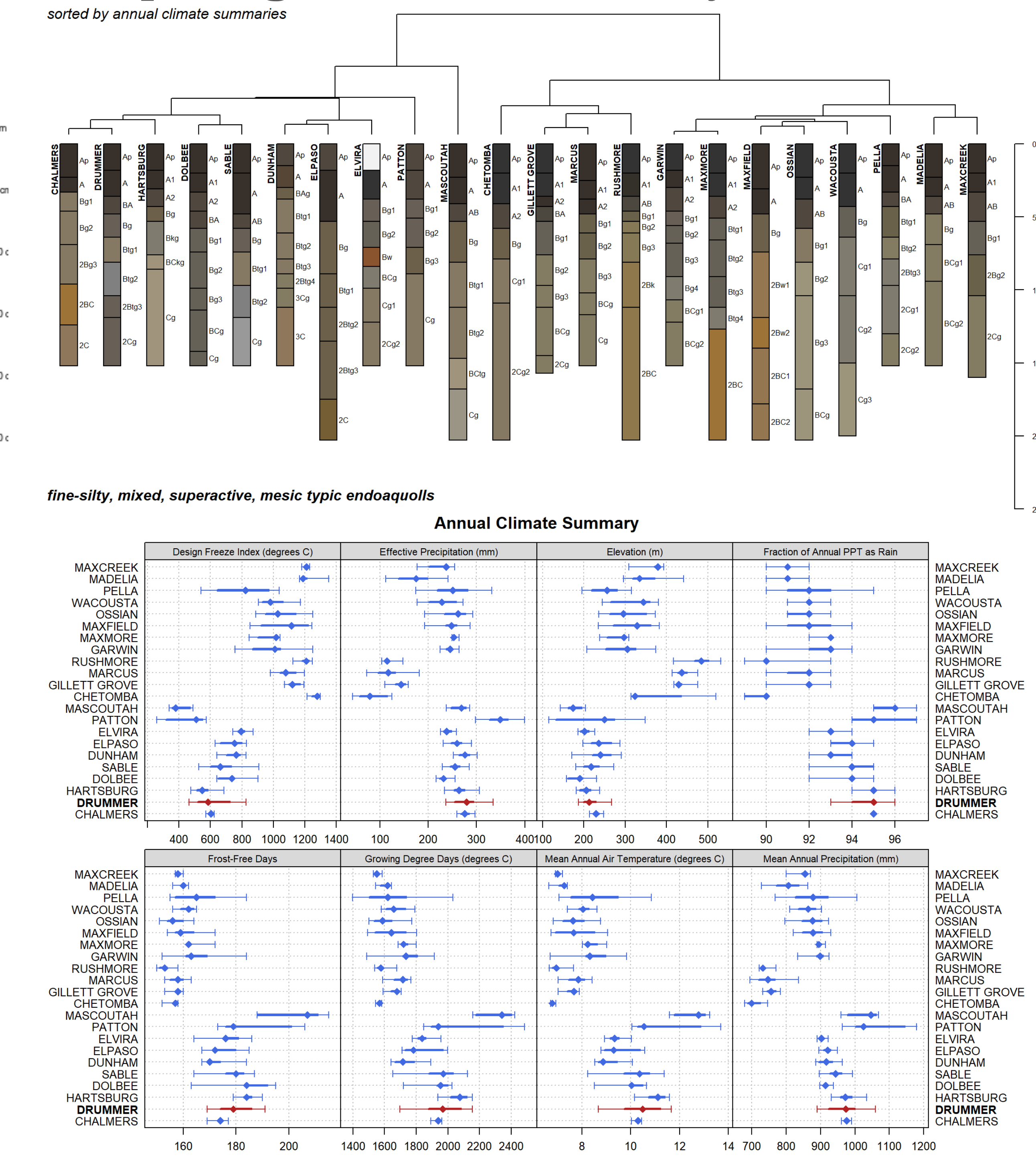
Data Sources

- Annual and monthly climate summaries: SSURGO + PRISM stack
- Geomorphology: SSURGO + geomorphons
- Parent material: normalized SSURGO records (pmkind / pmorigin)
- OSD narrative and morphology: exemplar pedon in NASIS
- Range in characteristics (RIC): aggregation of *curated* NASIS + KSSL data
- Setting and associated soils: MLRA + SSURGO, siblings / competing

Siblings: co-occurring within map units

Hillslope Position: sibling
Toeslope | Footslope | Backslope | Shoulder | Summit

Geomorphic Component: sibling
Interfluve | Crest | Head Slope | Nose Slope | Side Slope | Base Slope

Competing Series: same family classification

sorted by annual climate summaries

fine-silty, mixed, superactive, mesic typic endoaquolls

Annual Climate Summary

fine-silty, mixed, superactive, mesic typic endoaquolls

fine-silty, mixed, superactive, mesic typic endoaquolls

Hydrologic Ordering via Hillslope Position Proportions
Toeslope | Footslope | Backslope | Shoulder | Summit

- ncss-tech.github.io/AQP/soilDB/soil-series-query-functions.html
- ncss-tech.github.io/AQP/soilDB/competing-series.html
- github.com/ncss-tech/soil-range-in-characteristics

Explicit, quantitative, human/machine readable encoding of historic (and future) soil knowledge.

Available now via `soilDB` library for R / **SoilWeb**

- series morphology, taxonomy, drainage class, etc. (from OSD)
- hillslope position / geomorphic component mountain position
- parent material kind / origin
- MLRA "membership"
- acreage / number of components
- annual and monthly climate variables (from PRISM)
- "siblings" / "cousins" (siblings of siblings)
- competing series (via SC database)
- KSSL + subset of morphology, by latest correlated taxonname
- full-text search of OSD sections, optionally subset by MLRA

TODO list for NRCS / NCSS / Pedology

- SoilWeb has been the proving ground for these concepts but this cannot scale to concurrent input from all NRCS staff (absolutely required).
- Official series descriptions cannot accommodate proposed work, series concepts need a proper database that can draw from many sources of data.
- Collect supporting data (90% done) and house in NASIS or a new database.
- Standards for robust RIC must be written: percentiles | probability best bet.
- Develop methods for generating the OSD from a *combination* of statistical summaries *and* narratives crafted by experts.

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